

High Operating Temperature, Radiation-Hard MIM Thermophotovoltaic Converters, Phase II

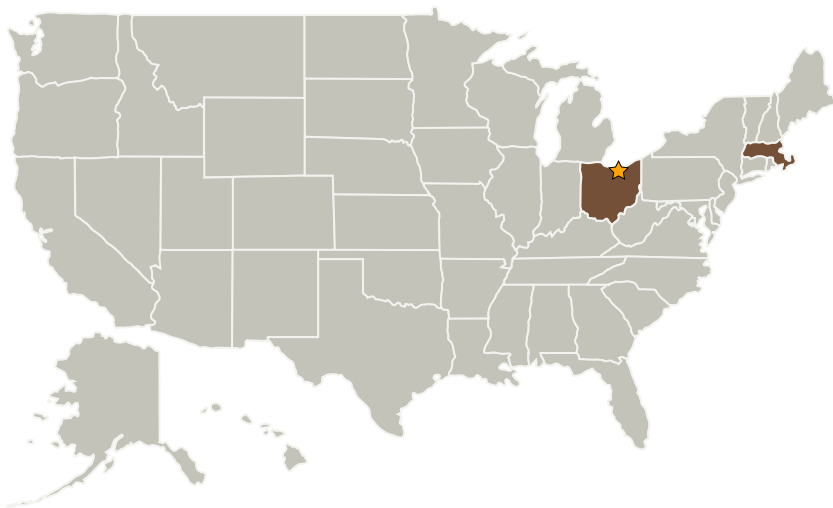
Completed Technology Project (2006 - 2008)



Project Introduction

Spire Corporation is developing a key component for thermophotovoltaic (TPV) power technology for deep space missions. We are developing InGaAs monolithically interconnected modules (MIMs) that convert thermal photons from the $\sim 1100^\circ\text{C}$ General Purpose Heat Source (GPHS) into electrical power. The innovation is that these MIMs are designed to operate at higher cell temperatures (150°C) and be more radiation-hard than current MIMs to better match the cell environment on missions. In Phase 1, we developed a model that predicts an optimum InGaAs bandgap (adjustable during epigrowth) for the operating temperature and 1100°C blackbody GPHS spectrum of $\sim 0.7\text{eV}$, made sample devices, and tested temperature coefficients to confirm the model and measured data agree (e.g. model predicts $-1.7\text{mV}/^\circ\text{C}$ for V_{oc} vs. $-1.8\text{mV}/^\circ\text{C}$ for data). In Phase 2, we will perform five iterations of a model, design, epitaxially grow, process, and test cycle. Data from each cycle will be used to improve the next design. Testing will include both radiation, temperature stability and accelerated life testing. Before program completion, we will survey NASA and commercial space power contractors for needs and make samples of the best design to distribute among space power contractors as a step toward generating interest and commercial sales.

Primary U.S. Work Locations and Key Partners



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★ Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Spire Corporation	Supporting Organization	Industry	Bedford, Massachusetts

Primary U.S. Work Locations	
Massachusetts	Ohio

Project Transitions

 **December 2006:** Project Start

 **December 2008:** Closed out

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX14 Thermal Management Systems
 - └ TX14.1 Cryogenic Systems
 - └ TX14.1.3 Thermal Conditioning for Sensors, Instruments, and High Efficiency Electric Motors